Exploring the role of curriculum materials in teacher professional development

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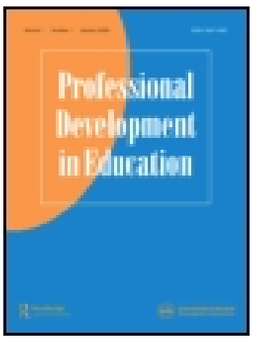

Professional Development in Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rjie20

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To cite this article: Nick Moore , Mike Coldwell & Emily Perry (2021): Exploring the role of curriculum materials in teacher professional development, Professional Development in Education, DOI: 10.1080/19415257.2021.1879230

To link to this article: https://doi.org/10.1080/19415257.2021.1879230

Published online: 09 Feb 2021.

PROFESSIONAL DEVELOPMENT IN EDUCATION
https://doi.org/10.1080/19415257.2021.1879230

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ABSTRACT

Curriculum materials (schemes of work, lesson plans, etc.) play a complex and pivotal role in school and teacher practices. The adaptation and development of curriculum materials often constitute part of teacher professional development (PD) activities. However, compared with research examining the relationship between PD and teacher professional change, the role of curriculum materials in professional learning remains under-researched and under-theorised. We address this gap by applying a multi-perspectival approach to data from a PD programme in which teachers were supported to develop curriculum materials. We use an interconnected model to analyse the role of curriculum materials in catalysing change in individual teachers' practice. Our use of Boundary Theory proposes that curriculum material adoption is mediated by the solidity of boundaries between school practice and research findings, and Actor-Network Theory perspectives examine the assemblage of networked relations within and beyond schools that are entangled in curriculum materials. We highlight how combining linear and non-linear perspectives may contribute to improved understanding of the complexity of supporting teachers' learning and use our analyses to outline implications of using curriculum materials in teacher professional development.

ARTICLE HISTORY
Received 4 June 2020
Accepted 22 December 2020

KEYWORDS
Actor-network theory; boundary object; curriculum materials; interconnected model; multi-perspectival; professional development

Introduction

Curriculum materials play a central and complex role in the school system. By curriculum materials, we mean artefacts that represent and guide the content, pedagogic approaches and sequencing of teaching, whether over a single lesson or a series. These include classroom activities, lesson plans, assessments, curriculum plans and schemes of work (SoWs) (Charalambous and Hill 2012). Curriculum materials relate school and teacher practices to subject content, aims, pedagogic approaches, timing and sequencing (Ball and Cohen 1996). Putting aside a wider discussion of their values and purposes (e.g. Apple 2004), curriculum materials often play a role in teacher professional development (PD), through formal, informal and collaborative processes (Timperley *et al.* 2007, Doyle *et al.* 2020), and the use of new or revised curriculum materials is sometimes taken as evidence of implementation of the aims of PD activity (Lydon and King 2009, Saderholm *et al.* 2017). However, there is little research or theorisation of how curriculum materials contribute to teacher professional learning. This contrasts with advances made in examining teacher professional development more broadly (e.g. Desimone 2009, Cordingley *et al.* 2015, Kennedy 2016), including approaches that recognise complexity and multiple perspectives (Opfer and Pedder 2011, Boylan

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et al. 2018). This paper contributes both to the empirical research base and its theorisation using a novel multi-perspectival approach.

Teacher professional development (PD) often involves curriculum materials, from the provision of new curriculum materials, sometimes supplemented with additional information or support, to collaborative design and use of classroom activities through models such as lesson study (Timperley *et al.* 2007, Elliott 2019). Curriculum materials are assumed to facilitate teachers' enactment (Kennedy 2016) of new or revised ideas and practices, whether they are provided by external PD facilitators or devised with or by teachers themselves. The impact of curriculum materials on teachers' professional learning is unclear (compare Shawer 2010, Doyle *et al.* 2020), however, and the mechanisms by which curriculum materials contribute to professional learning, while probably complex and varied, are under-theorised.

The empirical basis for this paper's multi-perspectival approach to considering the role of curriculum materials in professional development is a professional development programme for teachers from primary schools in England. The programme focussed on improving teaching for children who use English as an Additional Language (see below). To analyse data collected from an evaluation of the programme (Culliney *et al.* 2019), we use three contrasting theoretical perspectives: an interconnected model of teacher professional growth (Clarke and Hollingsworth 2002), boundary theory (Star 2010) and Actor-Network Theory (Fenwick and Edwards 2010). These perspectives enable us to shift the focus, respectively, from the professional development of individual teachers, to the realms of school practice, professional development programmes and research findings, and then out to the networks that bind classrooms to schools and to national bodies. Collectively, the three perspectives contribute complex linear and non-linear interpretations of the role of curriculum materials in professional learning, complementing the original evaluation (Culliney *et al.* 2019). Drawing on Boylan *et al.*'s existential and epistemic pragmatism which 'considers different epistemologies and ontologies as perspectivally useful' (2018, p.137), we view our perspectives as complementary, accepting that no single analysis can adequately describe the complexity of teacher professional learning and development (or, indeed, the social world more broadly). Only the limitations of space prevent the inclusion of additional perspectives. Therefore, we offer this novel multi-perspectival approach as a means to explore the complexity of interactions between two individually complex components of the system: curriculum materials and teacher professional learning.

Context

The context of the study is a teacher professional development (PD) programme to improve teaching for pupils who use English as an Additional Language (EAL) (Education Endowment Foundation 2019). The PD programme supported teachers with a significant proportion of EAL pupils in years 5 and 6 (9–11 years old), partly through supported adaptation and implementation of curriculum materials, specifically Schemes of Work (SoWs). The programme trainers provided sample SoWs for teachers to adapt to their classrooms, and supported them to develop and trial their own SoWs based on the programme's aims and intended outcomes.

The programme, commonly referred to as LiLAC (Language in Learning Across the Curriculum), used functional-linguistic and genre pedagogy theory (Rose and Martin 2012) to integrate pedagogical principles and practices with the literacy demands of school subjects. Forty schools across England volunteered to take part in the programme and in a Randomised Control Trial (RCT) with associated Implementation and Process Evaluation (IPE), including 17 schools that agreed to act as case studies (Culliney *et al.* 2019). The linear approach to change in this programme described in the programme's logic model (Culliney *et al.* 2019) is typical of transmissive models of professional development (Kennedy 2014). Therefore, teachers' conformity (their fidelity or integrity) to a training programme can qualify any evaluation of the training, particularly

in RCTs (Humphrey *et al.* 2019). Approval for the study was received as part of standard university ethics review processes.

Analysis

In this section we outline the datasets used in the three approaches. For the first two approaches – an interconnected model of teacher professional growth and boundary theory – we use interview data from the case studies for the IPE. At each case study school, researchers observed at least one lesson and interviewed teachers and school leaders involved in the PD programme. Transcripts of interviews with forty individuals (23 teachers and 17 school leaders) from these 17 schools were analysed thematically, using an approach in line with Framework Analysis (Smith and Davies 2010). This involves undertaking an initial examination of the data to develop an overarching initial framework, producing more detailed coding to themes and then a final interpretative analysis of data within codes. The third analysis, using Actor-Network theory, drew on a different dataset: 212 SoWs that were submitted by 35 of the 40 schools for the IPE as a measure of fidelity to the principles of the LiLAC programme. Further details of the analytical approaches are included below.

Curriculum materials in teacher professional growth

In our first analysis, we use an interconnected model of teacher professional growth (Clarke and Hollingsworth 2002) to consider the role of the curriculum materials as it relates to individual teachers' professional learning and change. The interconnected model (Figure 1) has been used to theorise, analyse and plan teacher professional learning, for example, to categorise the aims of professional development programmes in science education (van Driel *et al.* 2012) and to analyse the professional learning of teachers and PD facilitators (Hartnett 2011, Perry and Boylan 2018).

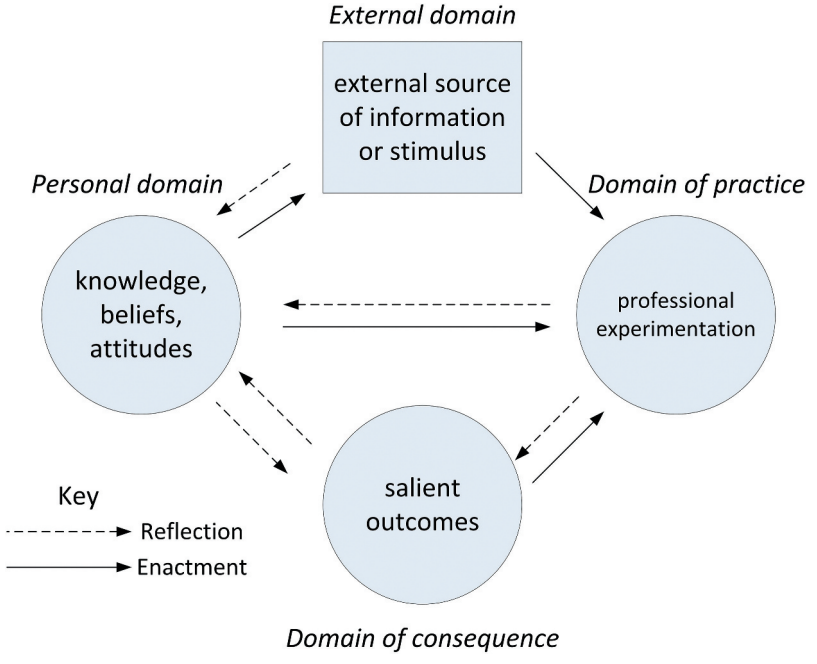

Figure 1. Interconnected model of teacher professional growth (Clarke & Hollingsworth 2002, p.951).

The model identifies four domains of change within the 'teacher's world' (Clarke and Hollingsworth 2002, p. 950): the external domain (information, resources and other inputs to the professional development process); the personal domain (teachers' knowledge, beliefs and attitudes); the domain of practice (classroom and other activities carried out by the teacher); and the domain of consequence (outcomes such as pupils' engagement, behaviour and learning). Processes of enaction and reflection mediate change between the domains.

The interconnected model goes beyond other 'single pathway' (Boylan *et al.* 2018) models (e.g. Guskey 2002, Desimone 2009) to show the complexity of teacher professional learning. It offers a variety of routes to change, including feedback loops and cycles. Change may begin in any of the domains and does not necessarily proceed along a predetermined, linear path (Andersson and Palm 2017).

In this study, the model was used as an interrogatory tool (Clarke and Hollingsworth 2002) for a thematic analysis of data from interviews with teachers and school leaders who participated in the PD programme. If change was reported to have taken place in a teacher's classroom practice, this was coded as 'professional experimentation' in the domain of practice. Change related to teachers' knowledge or understanding was coded as change in the personal domain. Where change was identified which related to pupil outcomes, this was coded as change in the domain of consequence. The external domain was used for interactions between teachers and the facilitators of the PD programme (see below for further discussion of the external domain). Changes for each teacher were then linked into 'change sequences' (Clarke and Hollingsworth 2002) to describe the pathways of change from one domain to the next. For simplicity, we did not differentiate the two mediating processes of enaction and reflection. For some teachers, change sequences contained a single step from one domain to another. For others, change sequences formed cycles passing through multiple domains, and, in some cases, moved from change for an individual teacher to change across a group of teachers within a school.

The change sequences were grouped and named for the first 'step' in the sequence. Each group is described below.

Change sequence 1: External to practice

In these change sequences, change began with an input in the external domain, from the facilitators of the professional development programme, sometimes taking the form of curriculum materials provided as exemplars of new practice. This led to professional experimentation, as teachers adopted these new practices. The curriculum materials acted as a stimulus for change.

> I can take this and put it into my lesson tomorrow. So it's all really useable resources or activities that you can just put into your teaching straight away [Teacher, School F]

> [The facilitator] sat with us and she was helping us with putting things into our planning . . . it's the ideas that you can just put into whatever you were teaching. [Teacher, School B]

For many teachers, this change in practice using the curriculum materials was perceived to lead to improved pupil learning: a change in the domain of consequence. This in turn led to a change in the personal domain, with teachers feeling that new practices, as exemplified in the curriculum materials, were an improvement on their previous practice (Figure 2).

For some teachers, external contexts formed barriers to change, and individual teachers' change sequences varied depending on their classroom contexts. In School B, for example, teachers of Year 6 pupils felt their ability to adopt new approaches was hindered by the need to prepare pupils for national curriculum tests, alongside a set, structured SoW.

> In Year 6 it's a real struggle, because we follow . . . a set guided thing, so we can't amend that or anything. So the only time we can implement it really is within the topic work, properly, and I have one afternoon a week for that now. [Teacher, School B]

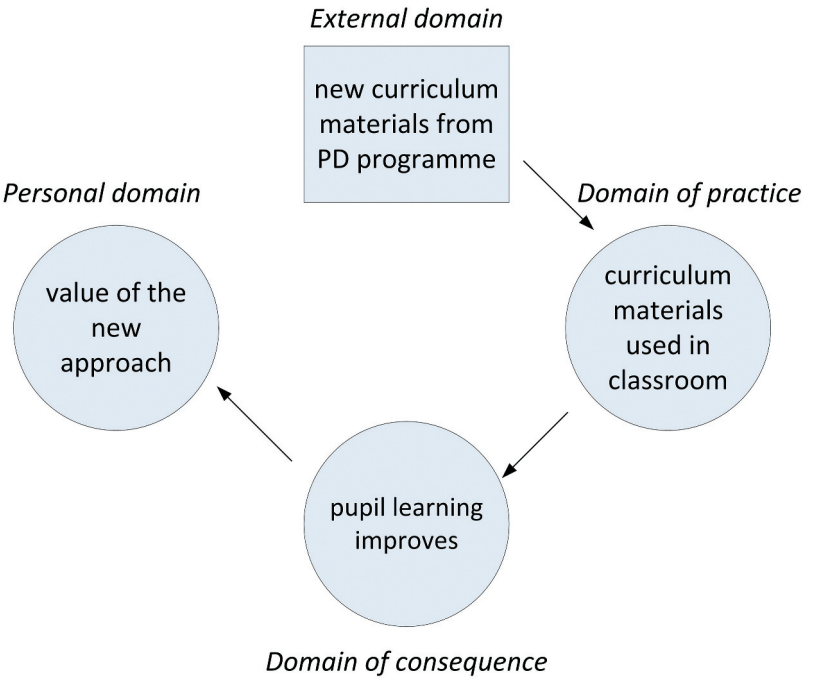

Figure 2. Extended external to practice change sequence.

By contrast, in other schools, the change sequence extended further as teachers, with the support of senior leaders, disseminated the 'ideas' embodied in the curriculum materials to colleagues, who in turn adopted new approaches in their own practice (Figure 3).

> I think being able to share ideas with them [colleagues] and getting ideas of how they've used and adapted it in their classes . . . Then through that I can maybe adapt what I'm doing, that's a good idea, I'll borrow that one. [Teacher, School D]

In these change sequences the focus shifts from an individual teacher to the wider school, as new and adapted curriculum materials support the adoption of new practices by colleagues. We use 'social domain' (Perry and Boylan 2018) here to differentiate interaction between colleagues from interactions with the facilitators of the PD programme (the external domain).

Change sequence 2: External to personal

For some teachers, the PD programme, and by association the curriculum materials, did not lead in the first instance to a change in practice, but instead prompted a new understanding of how current approaches to teaching could be improved: a change in the personal domain.

> [The PD programme] opened our eyes to the difficulties that EAL [English as an Additional Language] students can face when it's not the language that they speak at home every single day. [Teacher, School E]

The curriculum materials provided a route by which the teachers could apply this new understanding to their practice, thereby extending the change sequence to the domain of practice (Figure 4).

As above, in some schools, change sequences extended further, through the 'social' domain, as new and adapted curriculum materials were disseminated to colleagues.

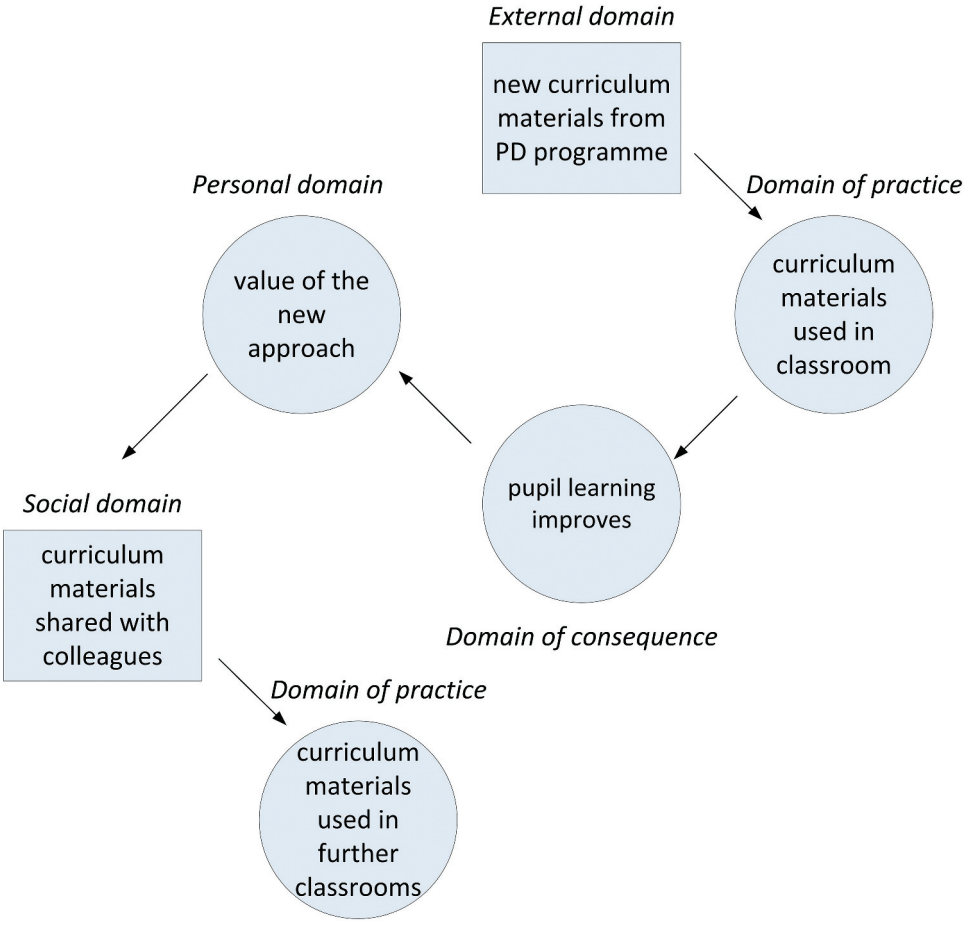

Figure 3. Extended external to practice to social domain change sequence.

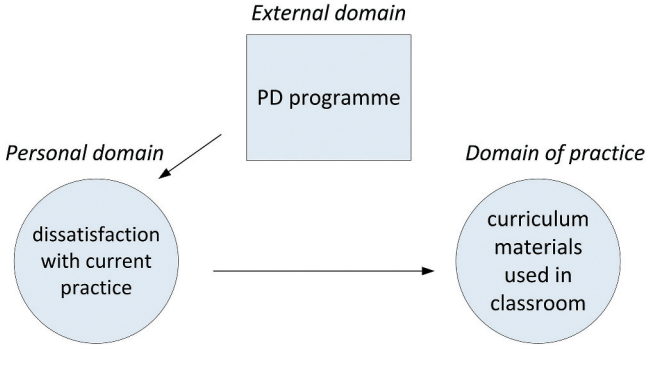

Figure 4. External to personal change sequence.

Change sequence 3: Personal to external

Prior to the opportunity to engage in the PD programme, some schools had identified a need to change teachers' practice, in response to changing pupil demographics.

> We were interested in language right across the school, but we saw it as a bit of a catalyst and a stepping stone to actually let's look at this whole school . . . It's becoming a particular issue for us as our cohorts are starting to

> change. We've got a lot of children coming into school with very poor speech and language and communication skills. [Headteacher, School F]

This understanding of the current situation acted as a stimulus for participation in the PD programme, leading to a change sequence which starts in the personal domain, then passing to the external domain and, through the use of new curriculum materials, to the domain of practice (Figure 5). As above, for some teachers and some schools, this change sequence could again be extended, to the domain of consequence and beyond.

These change sequences illustrate how teacher change can be facilitated by curriculum materials through their adoption and adaptation as part of professional development. The curriculum materials play two roles: they are part of the process of professional development and also an outcome of the changes generated through professional development. In the sections which follow, we move the focus away from the teacher to examine how curriculum materials operate and are constituted within the change environment.

Curriculum Materials as Boundary Objects

In this section, we shift the focus to the role of curriculum materials in facilitating knowledge production at the boundary between social spaces. We draw on Engeström *et al.*'s (1995) concept of boundary, which is captured well by Akkerman and Bakker (2011, p. 133) as a 'sociocultural difference leading to discontinuity of action or interaction'. The difference here is between two spaces or sites, with the aim being to bridge them to create productive social action. This differentiates Engeström *et al.*'s position from other research into boundaries in the social sciences which focus on boundary difference and maintenance (e.g. Tilly 2004). In the Engeström *et al.* conception, the boundary is a creative, shared space described by Lamont and Molnar (2002, p. 18) as an 'interface, facilitating knowledge production'.

The sites we examine here are the school – and its practices – on one side of the boundary, and the PD programme – its aims, developers and facilitators – on the other. These sites have sameness and continuity in relation to a shared focus on teaching and learning; yet there is also discontinuity. The PD programme aims to integrate learning from the programme into school practices, starting from a belief that the programme encapsulates prior evidence of effective teaching in relation to language. The starting point of the school is its current practices and context, aiming to provide the best learning outcomes for the pupils. Using boundary theory, we can theorise that the discontinuities between the PD programme and current school practices can be overcome by the use of 'boundary objects' (Star 1989) – artefacts that can act to bridge between different social worlds, allowing smooth boundary crossing by providing a bridging mechanism, and acting as 'a means of translation' (Star and Griesemer 1989, p. 393). Akkerman and Bakker (2011) describe how boundary objects can 'allow different groups to work together, based on a back-and-forth movement' (p141).

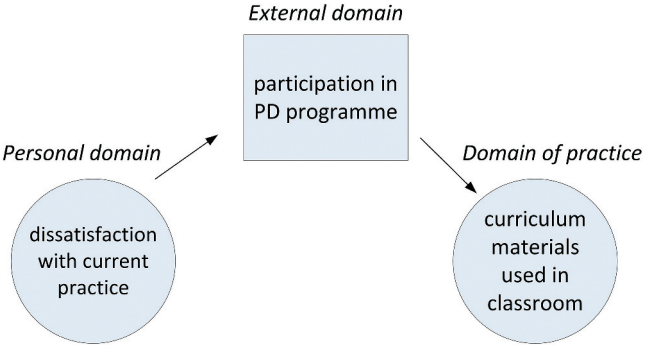

Figure 5. Personal to external change sequence.

Boundary theory and boundary objects in education

The uses of boundary objects in education often focus on artefacts produced by others, which are then considered and interpreted by those engaged in teaching. For example, Banner *et al.* (2012) consider the role of curriculum materials, specifically an element of a nationally-produced science curriculum. Although their study primarily examined the implementation of these externally produced (from the teachers' perspective) curriculum materials, Banner *et al.* also discuss their interpretation at a local level which moves towards the focus of the current paper where teachers at least partially produce the boundary objects.

The boundary discussed in this paper is in part between research and practice, since the PD programme in this study was based on research evidence relating to functional linguistics. Whilst there is a range of literature relating to communication processes associated with use of research in teachers' practice (as well as teacher characteristics and school characteristics: see Coldwell *et al.* 2017), there is little on the role that curriculum materials might play in mediating between research and practice. Even within the literature that explicitly considers the role of PD in bridging research into practice (Cordingley *et al.* 2015) there is little consideration of the potential role of curriculum materials as mediators.

In summary, then, the perspective used in this section examines data from the study in relation to the actual and potential ways in which the programme facilitators, schools and teachers work with the curriculum materials as boundary objects, in particular bridging relationships between PD and practice.

Curriculum materials as boundary objects

Whilst the role of the curriculum materials in this study was conceptualised in the PD programme in simple, linear terms as the development and production of materials, in practice their role varied. In most cases, the development of schemes of work was an iterative process, comparing, combining with and amending existing curriculum materials. The extent to which this involved significant creative work depended on the school and wider context. We conceptualise this as being dependent on the solidity or porosity of the boundary.

SoWs were designed to incorporate LiLAC principles, but none were created from scratch. In a small number of cases a porous boundary between the school curriculum and the PD programme allowed the development of the SoW to act as a boundary object via a rich process of dialogue between teachers, often including school leaders, linking to and from existing curricula and looking beyond the specific focus of the programme. In School A, for example, the senior leader commented on the benefits of teachers working together:

> I think because they were able to produce a really good scheme of work, that's helped the delivery and because they worked together on it, it helped their confidence I think for both of them as well. They knew what they were teaching and they could see the link between the two, rather than it being a separate scheme of work. [Senior leader, School A]

At School D, too, joint working on the scheme of work was important, with links made across the school which led to further rich thinking, building changes to curriculum development (in this case, linking to the 'inference grid', a tool introduced to help with developing the scheme of work) beyond the intentions of the programme:

> I think if you are doing it as a staff, you can do it progressively as well. . . . So maybe when they get to Year 6 the inference grid might look slightly different to a Year 3 grid, so you could use texts that are a little bit more complex (Teacher, School D].

However, the level of integration in this school was far from the norm. Across our sample, schools engaged in various processes of developing and re-developing current curriculum plans and SoWs, drawing on LiLAC principles. At School A, one teacher considered how LiLAC could fit with

specific elements of lessons such as starter activities, and in most cases teachers discussed 'slotting', 'fitting' or 'dovetailing' LiLAC with what was already in place:

> We already had a very detailed planning system in place . . . . we already had a general scheme of work and we were just slotting LiLAC in where it would be better than other activities that we already had in place. [Teacher, School E]

In a small number of schools, the boundary was very solid, restricting the development of the SoW to little more than a comparison of the existing scheme with the expectations of the programme. At School B, there was a process of cross-checking and identification of 'coincidence' with a current off-the-shelf curriculum package being seen as 'complementary' (senior leader) to the expected LiLAC model: 'we follow [external curriculum model] now, which is a set guided thing, so we can't amend that or anything' (teacher, School B).

In the only school in our sample (School J) that described having a poor experience of the project, the LiLAC programme was seen to be unoriginal and no better than current practice. This was described by one teacher as 'a poor man's' version of the school's current curriculum model. In this school, the SoW failed to act as a boundary object; there was little smoothing of the relationship.

In many schools, the solidity of the boundary also related to the strong focus on external national curriculum tests at the end of Year 6 ('SATs') – a key accountability measure for English primary schools:

> we haven't got the scope of other year groups where the pressure of SATs isn't there. [. . .] It's particularly pressured, because obviously you've got your SATs in May, so effectively you've got to get your Year 6 curriculum in, done, before May. [Teacher, School C].

In summary, our use of Star and Griesemer's (1989) Boundary Object concept, within Engeström *et al.*'s (1995) understanding of a boundary as a site of productive joint working, highlights the processes by which a SoW can act to help integrate learning from PD in school policies and practices. By focussing on the boundary as a working space rather than a linear barrier to cross, or indeed as part of a pathway as in the previous section of this paper, this analysis reveals how institutional contexts, personal relationships and influences of wider policy agendas, especially external testing and accountability frameworks, intersect to create or inhibit iterations between current practice, professional development and changing practices.

Analysing Curriculum Materials with Actor-Network Theory

Our third perspective involves Actor-Network Theory (Latour 2005). Actor-Network Theory or ANT

> is a disparate family of material-semiotic tools, sensibilities, and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which they are located. (Law 2009a, p. 141)

ANT describes networks of relations that constitute social action by removing axiomatic distinctions 'between the social and natural, between the material and cultural, the human and non-human and between the technical and social' (Fenwick and Edwards 2010, p. 3) to expose 'black-boxed' relationships that were previously inaccessible to observation and theory.

ANT perspectives anticipate that educational change is interpreted differently – literally, translated – in each context due to unique network relations, and the introduction of any kind of technology for curriculum change (including teaching methodologies) will not be uniform as a rule (Gaskell and Hepburn 1998, Waltz 2006). When establishing, transforming and maintaining practice in a network, ANT does not conceptualise learning and knowledge as unobservable internal change in theorisations by an individual (contrasting with Clark & Hollingsworth's (2002) model) but as a *relational effect* (Law and Hetherington 2002); learning is an adaptation, and an effect of disruption to the existing network of relations. Rather than focussing on the work at

the boundary between and across sites (Engeström *et al.* 1995), ANT traces the establishment and maintenance of network relations (Latour, B. 2005).

In ANT, material objects are no more or less significant than human actors as 'objects, bodies and texts are produced by and simultaneously produce social and economic relations' (Law and Hetherington 2002, p. 392). Because social processes are enabled by objects and because objects are the consequence of social processes (Waltz 2004), it is possible to discover networks of relations by investigating their entanglement in objects. As a contextualised object implicated in social processes in schools and PD, SoWs simultaneously constitute and enact these processes.

Law and Hetherington (2002) distinguish between three types of materiality: objects, bodies and text. Text is produced as a consequence of choices within the potential of the linguistic system, and meaning is derived from the dynamism produced between what was and was not chosen (Halliday 2013). As meaning is relative to other choices available in the linguistic system, teachers' textual choices in SoWs construe their curriculum; the textual choices in SoWs reflect and construct the enacted curriculum. This section focuses on text to examine the semiotic choices in SoWs that enable social processes in the networks of relations to enact material change in the classroom.

Analysis of schemes of work

A corpus approach was taken to reveal semiotic patterns in large datasets of text that otherwise lose saliency through ubiquity (Sinclair 1991). The corpus of SoWs analysed here totals 212 documents comprising 9,769 distinct words (Types) in 249,546 running words (Tokens). While all SoWs were produced by teachers for the IPE study (Culliney *et al.* 2019), they are typical of SoWs and the semiotic choices are the effect of all relevant network relations in curriculum development during the PD programme.

Keyword analysis (Scott and Tribble 2006) was used to identify which words in the SoWs were used more frequently than would be expected in 'normal' English (represented by the written portion of the British National Corpus). Wordsmith Tools (Scott 2016) compared the relative frequency of each word in the SoW corpus to its relative frequency in the BNC corpus using the log-likelihood ratio. By identifying the most statistically unexpected choices, Keyword analysis highlights meanings valued above others and can 'reflect what the text is really about, avoiding trivial and insignificant detail.' (Scott and Tribble 2006, p. 56). We propose Keyword analysis to identify evidence of embedded network relations as a new method of material semiotics (e.g. Callon *et al.* 1986) in ANT studies.

The resulting list of Keywords (Appendix 1) provided prompts to investigate relational networks in the SoWs. As an object within the working environment of the school, the SoW embodies networks of relations. As with many objects, the semiotic content and configuration of the SoWs are the effects of network relations entangled within the object (Waltz 2004). This analysis searches for semiotic evidence of those relations.

Network of relations

Central to SoWs are *children*, also abbreviated as *chn*. Appendix 1 reveals that these are the most unexpectedly highly frequent items when compared to normal usage in written English – SoWs are more *about* children than anything else. Using an analysis of collocation in Wordsmith Tools (Scott 2016), we can examine how children are implicated in classroom activity. We find that on ten or more occasions in the SoWs, children and chn *have, write, complete, discuss, work, edit, engage, incorporate* and *need* (in descending frequency) while others *give, focus, remind, show, tell, encourage, support, provide, allow, have* and *guide* children or chn. Processes involving children permeate the SoWs in stark contrast to the other key actor in the classroom network and author of the SoWs – the teacher. Detailed analyses of concordances, collocations and original documents would further reveal the positioning of children and teachers in these networks of action.

In many SoWs, pupils are sorted into categories including *EAL* ('English as an Additional Language', 3rd most unexpectedly frequent word: Appendix 1), *FSM* ('Free School Meals', 33rd) and *SEN* ('Special Educational Needs', 42nd). These categorisations are neither arbitrary nor inevitable but the effects of broader social, political, economic and educational networks. For instance, EAL pupils are typically migrant children whose place in modern Britain has recently been highlighted by a series of election campaigns and the scapegoating of migrants for the cost of public services in national media (e.g. Black 2007). In categorising individual pupils, SoWs contribute to the enaction of economic and social stratification in the school curriculum.

Keyword analysis reveals instability in the network of relations from the LiLAC PD programme (Custance *et al.* 2012). The term 'LiLAC' (17th in Appendix 1) and many features of the LiLAC course network (Gaskell and Hepburn 1998) are common. It is likely that *EAL* (3rd), *text* (6th), *writing* (9th), *vocabulary* (10th), *sentences* (11th), *sentence* (23rd), *starter* (34th), *language* (35th), *paragraph* (43rd), *punctuation* (48th), *conjunctions* (49th) and *phrases* (50th) increased their relative frequency due to the instability introduced into the school networks by LiLAC training.

The SoWs employ technical terms specific to curriculum materials. Ranked 18th in Appendix 1, *ITAF* ('Interim Teacher Assessment Framework') is a consequence of a governmentality that controls a school's curriculum through national, standardised testing and through assessment and enforcement agencies (Standards and Testing Agency 2017, Ofsted 2019). Other curriculum-related terms in the SoWs include: *Learning* (14th), *Criteria* (19th), *WALT* ('We Are Learning Today', 25th), *Success* (38th), *LO* ('Learning Objectives', 40th), and *WILF* ('What I'm Looking For', ranked 144th). These terms and acronyms – the translations of network effects of PD practices and school and national policies – embed the views that teaching as a social process needs to be itemised and that greater value is placed on outcomes-based curriculum goals than on unmeasurable or incidental learning. These views are not inevitable but are typical relational effects within a regime of accountability and performativity (Ball 2003).

The ANT analysis (Fenwick and Edwards 2010), here guided by Keywords (Scott and Tribble 2006), provides semiotic evidence of relational networks of classroom interaction and activity, pupil demographics, teacher practice including professional development and views of curriculum, and government policy. The relational networks revealed by the semiotic choices in these objects combine to produce the enacted curriculum, and can also reveal instability in the networks, generated by PD activities for example. Further study is required to validate the Keyword approach to material semiotics and to establish the relational stability of the LiLAC innovation in these schools.

Discussion

Our three perspectives accentuate different aspects of the relationship between teacher professional development and curriculum materials: the varying change pathways for different teachers, the differing solidity of boundaries between new and old practice, and the different relational networks entangled within curriculum materials. We begin this section by highlighting key features of each of the analyses described above. These complement the original study's RCT and IPE design (Culliney *et al.* 2019) which examined a presumed cause-effect relationship to identify variables that influenced that relationship.

The change sequences, derived from an interconnected model of teacher professional growth (Clarke and Hollingsworth 2002), suggest that curriculum materials play a dual role: they are part of the process of teacher professional development and an outcome of that professional development. The change sequences follow complex, varying multiple paths and feedback cycles showing implementation logic but not necessarily causal mechanisms. A limitation of this analysis is that the specific role played by the curriculum materials in influencing teacher change remains somewhat obscure in the change process and, arguably, taken for granted by teachers and professional development facilitators.

To gain further insight into the role played by the curriculum materials, we used an analytic approach based on Boundary Theory (Akkerman and Bakker 2011). We found that when professional development and schools are seen as sites of action, curriculum materials facilitate the translation across the boundary between the two. We used the metaphor of boundary solidity to analyse the variable effects of curriculum materials in translating PD into school practices, with the rigidity of schools' approaches to their current curriculum as a key indicator. Where the boundary is less solid, curriculum materials were at least partially created by teachers. This element of creation distinguishes this analysis from the use of boundary objects in previous studies of curriculum. Boundary theory offers an emergent, interactional view to understanding the role of curriculum objects in PD to school practice changes, with an iterative consideration of work at and across a more or less solid boundary between PD and the teacher and/or school practice. While Boundary Theory may miss patterns of individual change processes, in contrast with path models such as the interconnected model of Clark and Hollingsworth (2002), its contribution is to expose the work of creation, adaptation and negotiation at the boundary of practices that produce teacher professional change and learning. Broader networks, including policy networks, are not developed here, and this is where we turn to ANT.

Our Actor-Network Theory analysis (Fenwick and Edwards 2010), driven by a corpus-based Keyword analysis (Scott and Tribble 2006), revealed that an assemblage of classroom, school and national network effects are negotiated and maintained through SoWs as curriculum materials. In SoWs, we find linguistic evidence of the contemporary local conditions which are the culmination of prior network effects (Gaskill and Hepburn 1998). ANT uncovers the network effects embedded in curriculum materials that are established and maintained in schools, and shows how these may be destabilised by PD. ANT perspectives identify learning and change as a relational effect, but they cannot draw causal links between events such as PD and learner outcomes because the underlying logic of ANT is one of a self-reproducing system.

Looking across our three analyses, the strongest commonality is the influence of the school and wider context, including: the attitudes, knowledge and histories of participating teachers and senior leaders; each school's curriculum and openness to change; pupil demographics; and the educational and social policy environment. The importance of context in moderating the impact of professional development is well-established (Desimone 2009, Evers, van der Heijden and Kreijins 2016). The contexts within which change processes play out are 'dynamic, agentic, relational, historically located, immanent and complex' (Coldwell 2019) and therefore, as we have shown, impact teachers' adoption, adaptation and enaction of curriculum materials. Our multiple perspectives help to explain the impact of these contextual factors by illuminating the ways in which curriculum materials and teacher professional development interact.

Our analyses demonstrate the complex, complementary ways that the role of curriculum materials in teachers' professional learning can be interpreted. We can assume curriculum materials cause change in a linear, transmissive model of professional development, acting as indicators of fidelity to a specified programme. In addition, curriculum materials can also be examined for their collaborative role in the complex change processes that teachers experience in professional development. Their creative role in easing the back-and-forth movement between the school space and the professional development and research space can be further studied as just one boundary that emerges and is negotiated in education. In addition, if we consider curriculum materials to be as implicated as people in the enactment of education, we can, by analysing keywords in these texts, trace the entangled logics of professional development, learning, government and the institution.

Conclusion

The multi-perspectival approach used in this paper offers insight into the complexity of the relationship between curriculum materials and professional development, illustrating its multi-faceted, interdependent nature, and its interactions with the wider context. We highlight the value that each of our interpretations provides (Boylan *et al.* 2018) and recognise that, due to limitations

of space, the complexity of the processes involved and the influence of their contexts, each approach would benefit from further exploration. These approaches complement the linear logic of the relationship underlying the original RCTs, and our understanding could be further enhanced with new perspectives. We particularly highlight the need to explore the longer-term political, societal and economic change processes – what Coldwell (2019) calls 'the historical context' – which modify teacher professional learning. There are glimpses here – Year 6 curriculum narrowing; education policy shifts; the positioning of 'EAL' children – but in general, these are beyond the scope of most time-limited evaluative research studies.

Based on our analysis, we propose some implications for practice, for those who design and facilitate professional development using curriculum materials. Curriculum materials, even those provided as exemplars, are almost certain to be adapted depending on schools' and teachers' contexts and existing practices. Therefore, those who design and facilitate professional development may wish to consider, firstly, whether the provision of curriculum materials is likely to be the most effective way of achieving the intended outcomes of the PD activity, or whether other approaches (teacher research, collaborative curriculum design, etc) might be more appropriate. Where curriculum materials are used in PD activity, the professional developers and teachers will likely benefit from considering the impact of context-driven adaptations on the research, principles and relations embedded in the curriculum materials.

We conclude by highlighting how our multi-perspectival analysis enables more than just different viewpoints on a phenomenon. Law and Ruppert (2013, p. 230) argue that research methods act as devices, or 'patterned teleological arrangements', that 'assemble and arrange the world in specific social and material patterns'. RCTs, for example, measure specified outcomes in structured 'interventions', which can reduce teaching, learning and professional development to a simplified linear model of change (Pearce and Raman 2014). In this paper, we have repurposed data from an RCT to provide complementary non-linear perspectives. Law has written widely on how methods influence how the (social) world is, not merely how it can be described: 'methods are practices that tend to enact realities as well as describing them' (Law 2009b, p. 240). By providing richer, more complex understandings of the relationships between PD, teacher practice and curriculum materials, the insights from our multi-perspectival approach aim to both disrupt the enactment of a narrow understanding of teaching and learning and provoke new approaches to practice.

Acknowledgments

The data for this study were produced during the Integrating English study funded by Education Endowment Foundation, Bell Foundation and Philanthropy Unlimited and reported in Culliney *et al.* (2019). We are grateful to the anonymous reviewers whose comments helped to improve this paper. We take responsibility for any remaining errors or omissions.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1

Table 1. The 50 words most associated with SoWs compared with the BNC (Reference Corpus), ordered by log-likelihood.

Keyword	Frequency	%	Ref Corpus %	Log Likelihood
1. CHILDREN	2,682	1.07	0.03	13,113.98
2. CHN	1,228	0.49	0.00	12,806.36
3. EAL	870	0.35	0.00	9,051.68
4. LESSON	703	0.28	0.00	5,067.92
5. WRITE	913	0.37	0.01	4,324.89
6. TEXT	709	0.28	0.01	4,029.53
7. USE	1,455	0.58	0.06	3,981.21
8. DISCUSS	661	0.26	0.00	3,792.26
9.WRITING	781	0.31	0.01	3,622.59
10. VOCABULARY	442	0.18	0.00	3,621.14
11. SENTENCES	454	0.18	0.00	3,398.82
12. USING	934	0.37	0.02	3,361.14
13. WHAT	2,407	0.96	0.22	3,347.90
14. LEARNING	610	0.24	0.01	3,137.30
15. ACTIVITY	622	0.25	0.01	3,087.40
16. READING	680	0.27	0.01	3,048.97
17. LILAC	342	0.14	0.00	2,984.35
18. ITAF	282	0.11	0.00	2,950.53
19. CRITERIA	438	0.18	0.00	2,674.64
20. PLENARY	281	0.11	0.00	2,648.40
21. EXPLAIN	560	0.22	0.01	2,647.12
22. IDENTIFY	451	0.18	0.00	2,484.34
23. SENTENCE	414	0.17	0.00	2,408.69
24. GROUPS	593	0.24	0.01	2,384.45
25. WALT	264	0.11	0.00	2,378.45
26. HOW	1,382	0.55	0.11	2,282.88
27. FOCUS	438	0.18	0.00	2,266.88
28. QUESTIONS	578	0.23	0.01	2,238.28
29. ACTIVITIES	528	0.21	0.01	2,172.54
30. KEY	549	0.22	0.01	2,080.30
31. WWW	198	0.08	0.00	2,059.08
32. COMPREHENSION	241	0.10	0.00	2,004.41
33. FSM	192	0.08	0.00	1,996.37
34. STARTER	246	0.10	0.00	1,876.90
35. LANGUAGE	466	0.19	0.01	1,850.87
36. CLASS	531	0.21	0.01	1,831.90
37. SESSION	357	0.14	0.00	1,828.09
38. SUCCESS	526	0.21	0.01	1,826.34
39. FEATURES	440	0.18	0.01	1,817.85
40. LO	216	0.09	0.00	1,728.95
41. READ	575	0.23	0.02	1,721.52
42. SEN	185	0.07	0.00	1,680.81
43. PARAGRAPH	285	0.11	0.00	1,669.76
44. THEIR	1,865	0.75	0.24	1,651.10
45. CREATE	402	0.16	0.01	1,590.38
46. HTTP	151	0.06	0.00	1,579.90
47. WHY	838	0.34	0.06	1,543.87
48. PUNCTUATION	178	0.07	0.00	1,521.27
49. CONJUNCTIONS	149	0.06	0.00	1,473.70
50. PHRASES	214	0.09	0.00	1,380.24